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## What is claimed is:

A method for generating digital filters for tuning a hearing aid to enhance hearing ability comprising:

providing first digital data for a tolerance range for a target response curve representative of said enhanced hearing ability of sound level versus frequency;

frequency;

(loss curve)

providing second digital data representing an initial response curve of

an initial hearing ability to be enhanced of sound level versus frequency; ເຂດເຄວາຍຊາ comparing said first digital data to said second digital data and

determining whether said initial response curve is within said tolerance range; and

if said initial response curve is not within said tolerance range, iteratively generating digital audio filters, applying said digital audio filters to said second digital data to generate third digital data for a compensated response curve, and automatically optimizing the frequency, amplitude and bandwidth of said digital audio filters until said compensated response curve is within said tolerance range or a predetermined limit on the number of digital audio filters has been reached, whichever occurs first. ( Page 34 - \$\gamma 15 - Page 35 - \lambda 5 - \lambda

2. A method according to Claim 1, wherein said step of iteratively generating digital audio filters is performed by iteratively generating second order filters. (See fing 5 and page 15 line 10 - 25)

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3.	The method of Claim 1 wherein said initial response curve is an
audio	gram. (See Fin 11)

4. A method for generating a set of second order filters to tune a hearing aid to enhance hearing ability comprising:

providing first digital data for a tolerance range for a target response curve representative of said enhanced hearing ability of sound level versus frequency;

providing second digital data representative of an initial response curve of an initial hearing ability to be enhanced of sound level versus frequency;

comparing said first digital data to said second digital data and determining whether said initial response curve is within said tolerance range; and

if said initial response curve is not within said tolerance range,
generating a set of filters to tune said hearing aid by performing the following
optimizing steps iteratively,

digitally processing said second digital data to determine an n<sup>th</sup> (15 channel) set of initial parameters for an nth peak in said actual initial curve where said initial response curve is not within said tolerance range, including a frequency, and amplitude and a bandwidth for said peak, where n is the number of an iteration of said optimizing steps, digitally generating a compensating nth filter from said n<sup>th</sup> set of initial parameters, applying said n<sup>th</sup> filter

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to said second digital data and modifying said n<sup>th</sup> set of initial parameters to determine an n<sup>th</sup> set of optimum parameters for said compensating n<sup>th</sup> filter, to generate third digital data for an nth interim compensated response curve of sound level versus frequency, processing said third digital data to determine whether said nth interim compensated response curve is within said tolerance range, if said nth interim compensated response curve is not within said tolerance range, performing another iteration of said optimizing steps until said interim compensated response curve is within said tolerance range or a predetermined limit on the number of filters has been reached, whichever occurs first.

5. A method of Claim 4, wherein said step of digitally generating a compensating nth filter is performed by digitally generating a second order filter.

6. The method of Claim 4, wherein said initial response curve is an audiogram.

(	57	(7.) A method for generating filters for tuning a hearing aid to enhance
6	58	hearing ability comprising:
6	59	providing first digital data for a tolerance range for a target response
	70	curve representative of said enhanced hearing ability of sound level
	71	versus frequency;
,	72	providing second digital data for an initial response curve of said hearing
,	73	ability to be enhanced of sound level versus frequency;
,	74	comparing said first digital data to said second digital data and
0 0	75	determining whether said initial response curve is within said tolerance
	76	range; and
~ () ()	77	if said initial response curve is not within said tolerance range,
TŲ,	78	generating a set of compensating filters by performing the following
[],	79	single filter optimizing steps iteratively,
	80	digitally processing said second digital data to determine an n <sup>th</sup> set
	81	of initial parameters for an n <sup>th</sup> peak in said initial response curve
8	82	where said initial response curve is not within said tolerance range,
8	83	including a frequency, an amplitude and a bandwidth for said peak,
;	84	where n is the number of an iteration of said optimizing steps,
;	85	digitally generating a compensating n <sup>th</sup> filter from said n <sup>th</sup> set of initial
;	86	parameters,
1	87	applying said n <sup>th</sup> filter to said second digital data and modifying
	88	said n <sup>th</sup> set of initial parameters to determine an n <sup>th</sup> set of

optimum parameters for said  $n^{th}$  filter, to generate third digital data for an  $n^{th}$  interim compensated response curve of sound level versus frequency;

if  $\underline{n} > 1$ , performing the following joint filter optimizing steps iteratively and cyclically,

generating fourth digital data for interim computed response curves in which for each joint filter optimizing iteration one of said n filters is absent, and then performing said single filter optimization steps utilizing said fourth digital data to generate fifth digital data for an updated interim response curve,

digitally processing said fifth digital data to determine whether the most recent of said joint filter optimizing iterations has resulted in a change in said updated interim response curve greater than a predetermined amount of change, and if so continuing to perform said joint filter optimizing steps;

processing said fifth digital data to determine whether said n<sup>th</sup> interim compensated response curve is within said tolerance range, and if not,

performing another iteration of the foregoing steps until said interim compensated response curve is within said tolerance range or a predetermined limit on the number of filters has been reached, whichever occurs first,

but if so, ceasing performance of further iterations.

1	8.	A method according to Claim 7, wherein said step of digitally
2	gener	rating a compensating n <sup>th</sup> filter is performed by digitally generating a
3	secor	nd-order filter.
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5	9.	The method of Claim 8 wherein said initial response curve is an
6	audio	gram.
1	10.	A method for generating filters for tuning a hearing aid to enhance
2	hearii	ng ability of an individual comprising:
3	1	fitting said hearing aid to said individual; (See abstract)
4	•	్రార్లు (ఆడ్డ్) connecting said hearing aid to a source of audio digital signals; (ుం)
5	!	ره, وهر) providing said individual with a device to generate indication signals at
6	,	will;
7	9	(ાગ) generating and providing a first series of audio digital signals to said
8	!	hearing aid, each signal in said first series of signals having a selected
9	1	frequency and multiple power levels; (See 10 ft 38 h, 5 -16)
10	I	رالاه ک <sup>و ۱</sup> receiving said indication signal during said generation of a signal of a
11	:	selected frequency indicative of said individual hearing said selected
12		frequency; ( See page 38 lm 18 - 26)
13		providing a digital audio processing unit in said hearing aid for

processing received audio digital signals and providing processed audio

16	aid characterized by coefficients i
17	audio digital signals to effect said
18	providing a digital computer conne
19	audio digital signals and said indi
20	representative of said individual's
21	without filters determined from sa
22	programmed to determine said co
<b>□</b> 23	said hearing aid and providing sa
0 23 0 24 0 V 0 U 1 1	processing unit in said hearing aid
V D	
	11. A method according to Claim 10
_ _ _	programmed to determine said coeffici
* 1 2 3 3 4	providing second digital data for <u>a</u>
<b>□</b> 4	curve ability of representative of s
5	ability of sound level versus frequ
6	providing first digital data represe
7	said individual's hearing ability of
8	ເວດການ (ເວເສີ) comparing said second digital dat
9	determining whether said respons

and

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digital data, including applying digital audio filters for tuning said hearing n algorithms applied to said received digital audio filters; page 38 an 27- page 39 21/) ected to receive said first series of cation signals to generate digital data hearing ability using said hearing aid id first series of signals, said computer [ pefficients for digital filters for tuning id coefficients to said digital audio d.(page 37 m7-23)

), wherein said digital computer is ents by

a tolerance range for a target response said individual's enhanced hearing ency;

ntative of an initial response curve of sound level versus frequency; a to said first digital data and se curve is within said tolerance range;

if said response curve is not within said tolerance range,

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12	(threshold) iteratively generating coefficients for digital audio filters,
13	applying digital audio filters determined by said coefficients to said
14	first digital data to generate third digital data for a compensated
15	response curve, and
16	automatically optimizing said coefficients by optimizing the
17	frequency, amplitude and bandwidth of said digital audio filters until
18	said compensated response curve is within said tolerance range or
19	a predetermined limit on the number of digital audio filters has been
20	reached, whichever occurs first. ( fage 36 to 9 - page 37 to 6)

- 13. The method of Claim 11 wherein said first digital data is an audiogram.
- 14. An apparatus for generating filters for tuning a hearing aid for use by an individual, comprising:

a source of first audio digital data; ((()))

a digital audio processing unit in said hearing aid for processing said first audio digital data and providing processed audio digital data to said individual, including applying digital audio (filters) for tuning said hearing

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	T 0 4)	That I think them them them	

7		aid characterized by coefficients in algorithms applied to said first audio
8	0437 ty 9-	digital data to effect said digital audio filters; (مراكع لم حروة)  (اله)  a device for generating indication signals indicative of said individual
9	, ()	a device for generating indication signals indicative of said individual
10		receiving said first audio digital data; and ( pay 34 mb - toge 38 m 5 )
11		a digital computer connected to receive said first audio digital data and
12		said indication signals, said digital computer programmed to determine
13		said coefficients for digital filters for tuning said hearing aid and provide
14		said coefficients to said digital audio processing unit. (70% 18 4 5 - 16)
1	15	An apparatus according to Claim 14, wherein said digital computer is

15. An apparatus according to Claim 14, wherein said digital computer is programmed to generate second digital data representative of said individual hearing ability when using said hearing aid without filters determined from said first audio digital data and said indication signals and to determine said coefficients by

providing third digital data for a tolerance range for a target response curve of enhanced hearing of sound level versus frequency;

providing said second digital data, wherein said second digital data represents an initial response curve of hearing ability of sound level versus frequency;

comparing said third digital data to said second digital data and determining whether said initial response curve is within said tolerance range; and (Sue Fig. 10-13-1)

if said initial response curve is not within said tolerance range,

15	iteratively generating coefficients for digital audio filters,
16	applying digital audio filters determined by said coefficients to said
17	second digital data to generate fourth digital data for a
18	compensated response curve, and
19	automatically optimizing said coefficients by optimizing the
20	frequency, amplitude and bandwidth of said digital audio filters until
21	said compensated response curve is within said tolerance range or
22	a predetermined limit on the number of digital audio filters has been
⊋ 23	reached, whichever occurs first. ( የሬናድ 36 ዜ ዓ – የ <sup>ሬ</sup> ናድ 37 ఒ 6)
	16. A method for generating digital filters for tuning a hearing aid to
i N 2	enhance hearing ability, comprising:
3	providing first digital data for a tolerance range for a target response
17 12 4 5 5	curve representative of said enhanced hearing ability of sound level
<u>5</u> 5	versus frequency;
<b>≟</b> 6	providing second digital data representing an initial response curve of an
7	initial hearing ability to be enhanced of sound level versus frequency;
8	comparing said first digital data to said second digital data and
9	determining whether said initial response curve is within said tolerance
10	range; and <sup>κλιο</sup> <sup>γν</sup> θ
11	if said initial response curve is not within said tolerance range,

12	iteratively generating digital audio filters to compensate said initial
13	response curve,
14	applying said digital audio filters to digital signals representative of
15	received sound to generate third digital data, converting said third
16	digital data to an analog signal and providing said analog signal to
17	a speaker in said hearing aid,
18	generating fourth digital data representative of an enhanced
19	response curve of hearing ability of sound level versus frequency;
<u> </u>	comparing said first digital data to said fourth digital data and
D n 21	determining whether said enhanced response curve is within said
d 5 22 N	tolerance range; and
23	automatically optimizing the frequency, amplitude and bandwidth of
] ] 24 U ] 25	said digital audio filters until said enhanced response curve is within
ս ֆ 25 Դ	said tolerance range or a predetermined limit on the number of
± ± 26	digital audio filters has been reached, whichever occurs first.
1	17. A method according to Claim 16, wherein said step of iteratively
2	generating digital audio filters is performed by iteratively generating second-
3	order filters.
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5	18. The method of Claim 16 wherein said initial response curve is an

audiogram.

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8	19. The method of Claim 18 wherein said enhanced response curve is an
9	audiogram.
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11	20. A method for generating total log-integral metric digital data for
12	characterizing the perceived performance of a hearing aid, comprising the
13	steps of:
14	providing first digital data for N samples for a desired response curve of
15	acceptable hearing ability of sound level versus frequency;
<b>9</b> <b>4</b> 6	providing second digital data representing N samples for an initial
<b>4</b> 7	response curve of sound level versus frequency; and
0997708 099708	generating total log-integral metric data according to the formula:
19 10 10 10 10 10 10 10 10 10 10 10 10 10	$M = \sum_{i=1}^{N-1} log_{10} \left( \frac{f_{i+1}}{f_i} \right) \left[ \frac{ S(f_i)_{dB} - D(f_i)_{dB}  +  S(F_{i+1})_{dB} - D(f_{i+1})_{dB} }{2} \right]$
型 <b>2</b> 0	where:
21	M is the total log-integral metric,
22	f is the frequency,
23	D is the first digital data,
24	S is the second digital data, and

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digital data.

N is the number of samples of first digital data and of second